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SOUTHERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION

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ORGANIZATION

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SOUTHERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION
New Orleans, Louisiana

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F. M. SMITH
Administrative Officer

J. B. DAVIES
General Engineer, Plant Operation

SOUTHERN REGIONAL RESEARCH LABORATORY, New Orleans, Louisiana

PIONEERING RESEARCH GROUP

Plant Fibers
Pioneering Research Laboratory
C. M. Conrad
Principal Chemist

Seed Protein
Pioneering Research Laboratory
A. M. Altschul
Principal Chemist

COMMODITY RESEARCH LABORATORIES

Cotton Chemical Laboratory
F. S. Perkerson, Chief

Cotton Mechanical Laboratory
R. J. Cheatham, Chief

Engineering and Development Laboratory
E. L. Patton, Chief

Food Crops Laboratory
V. H. McFarlane, Chief

Industrial Crops Laboratory
T. H. Hopper, Chief

FIELD STATIONS

FOOD CROPS LABORATORY

U. S. Fruit and Vegetable Products Laboratory — Winter Haven, Florida
M. K. Veldhuis, In Charge

U. S. Fruit and Vegetable Products Laboratory — Weslaco, Texas
F. P. Griffiths, In Charge

U. S. Food Fermentation Laboratory — Raleigh, North Carolina
J. L. Etchells, In Charge

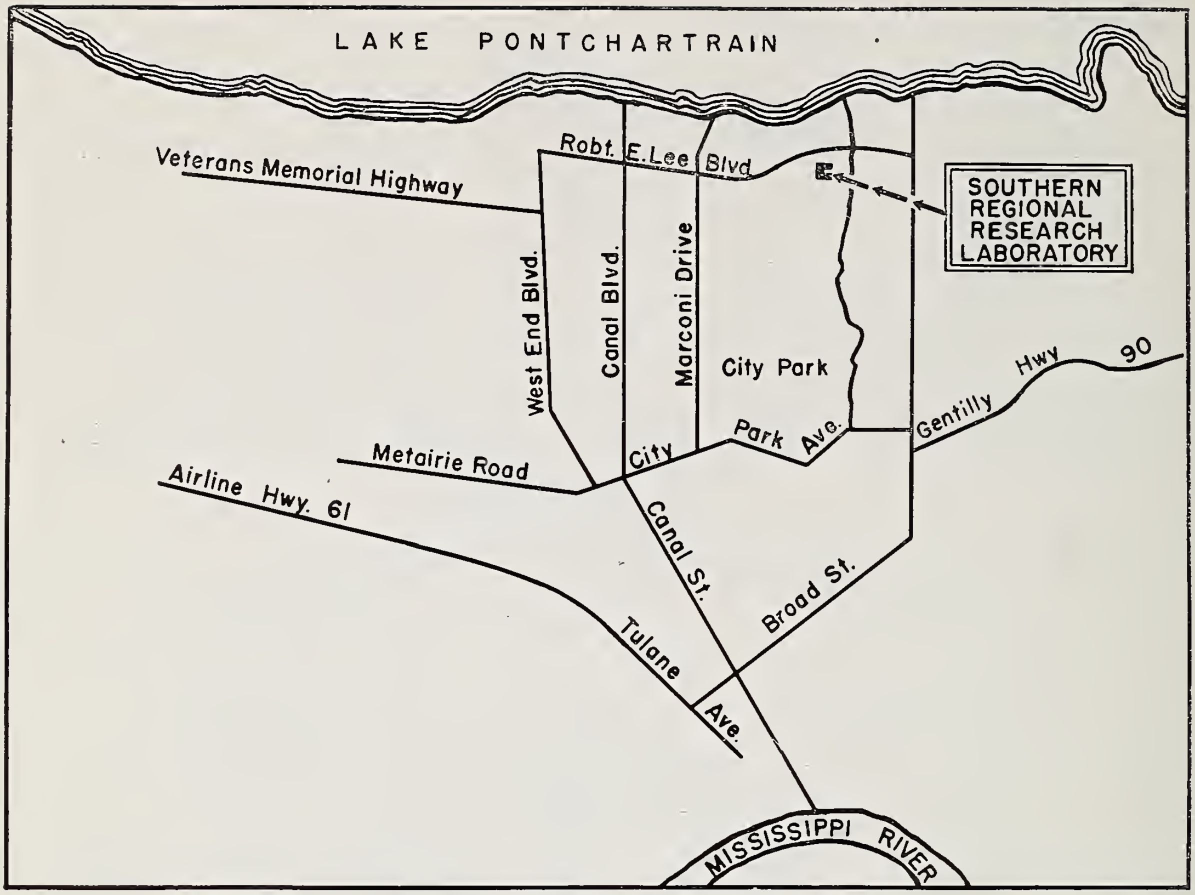
U. S. Sugarcane Products Laboratory — Houma, Louisiana
J. J. Friloux, In Charge

INDUSTRIAL CROPS LABORATORY

Naval Stores Station — Olustee, Florida
R. V. Lawrence, In Charge

U. S. Tung Oil Laboratory — Bogalusa, Louisiana
R. S. McKinney, In Charge

June 1958



Map of New Orleans
Southern Utilization Research and Development Division
Southern Regional Research Laboratory, 1100 Robert E. Lee Boulevard
P. O. Box 7307 New Orleans, La.

Telephone: FAirview 1441

VISITORS WELCOME

Visitors are always welcome at laboratories of the Division. Groups will be given conducted tours of the facilities. Arrangements should be made in advance to assure coverage of subjects of greatest interest. Conferences may be planned with staff members to discuss in more detail the specific phases of the research program. Children over 12 years of age may be included in the tours.

Location and Transportation: The headquarters of the Southern Division is located in the Southern Regional Research Laboratory north of City Park near Lake Pontchartrain, about 7 miles from the business center of New Orleans.

By Automobile. Drive from the business center toward the lake on Canal Street to the cemetery intersection, turn right, then left onto Canal Boulevard. Continue to Robert E. Lee Boulevard; then turn right, and drive about one mile to the Laboratory entrance.

By Streetcar and Bus. Board a Canal Street streetcar anywhere along the east side of Canal Street. At the end of the line walk about half a block east; board a "West End-Lake Vista" bus. This will circle through the Lakeview and Lake Vista sections, arriving at the Laboratory entrance from the east.

ORIGIN AND PURPOSE

In 1938 Congress enacted legislation directing the Secretary of Agriculture to establish, equip, and maintain four regional research laboratories, one in each major farm-producing area, to conduct research aimed at the development of new and extended markets for farm commodities, especially those in surplus.

With the establishment of these laboratories, utilization research as such became a recognized part of the program of the U. S. Department of Agriculture. Underlying this new research endeavor was the concept that a continuing, coordinated research program, such as that carried out by some large industrial concerns to further the utilization of their products, could be applied to utilization problems in American agriculture.

The Southern Regional Research Laboratory is one of these regional laboratories seeking increased and diversified utilization of farm products. The research on Southern farm crops conducted by the Southern Laboratory and the associated field stations of the Southern Utilization Research and Development Division has these general objectives:

To help farmers derive more income from their crops; to help industry convert agricultural raw materials into new and improved products; and to lower processing costs and improve the quality of farm-derived products.

In 1946 Congress enacted legislation called the "Research and Marketing Act," which included authorization for additional research on the utilization of agricultural commodities in the regional laboratories.

ADMINISTRATION

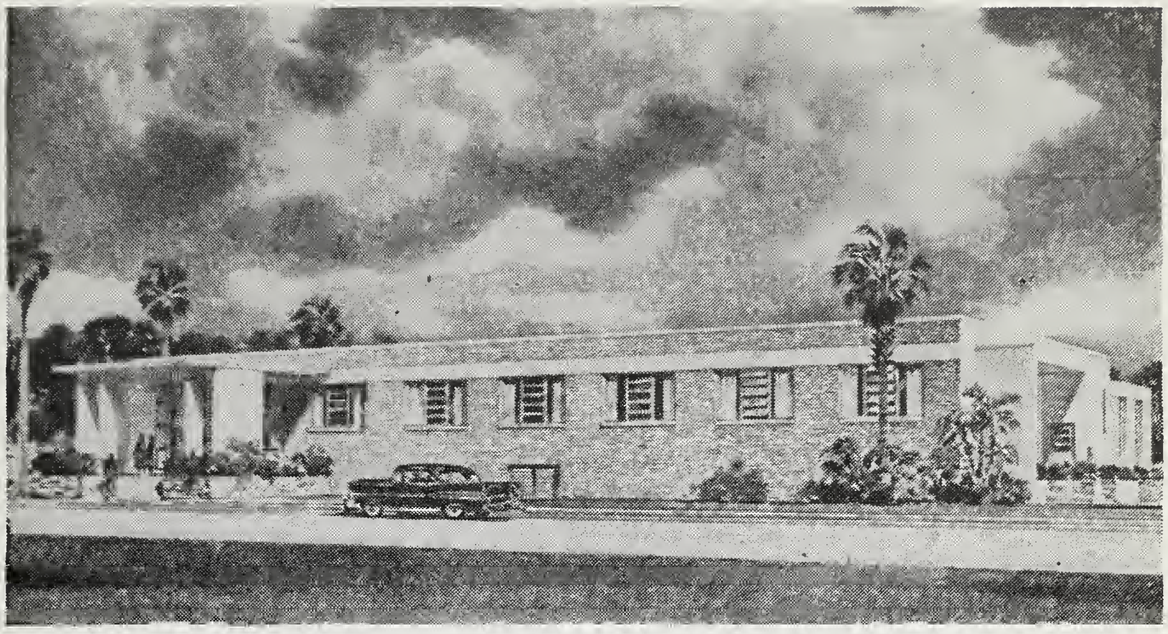
Most of the research in the U. S. Department of Agriculture is administered by the Agricultural Research Service. Utilization research is carried out in the four Regional Utilization Research and Development Divisions with headquarters located in New Orleans, La. (Southern Division), Philadelphia, Pa. (Eastern Division), Peoria, Ill. (Northern Division) and Albany, Calif. (Western Division).

The organization of the Southern Division is given on page 1. General information regarding all the Divisions is on the last page.

PHYSICAL FACILITIES

The Southern Regional Research Laboratory, first occupied in 1941, is located just north of City Park near Lake Pontchartrain on a 40-acre tract of land.

The U-shaped building has three floors and a basement. Floor area is almost 4 acres; the "U" base is 211 by 63 feet, wings are 306 by 66 feet. Offices occupy the base of the "U" at three levels; one wing houses 72 chemical laboratories; the other, an experimental textile mill and pilot plants for chemical engineering research. Most areas of the building are air-conditioned. Other buildings include a power plant, storage facilities, and a radiation laboratory.



Artist's Conception of the New Winter Haven Laboratory.

The Southern Division also operates research laboratories at Olustee and Winter Haven, Fla.; Bogalusa and Houma, La.; Weslaco, Texas; and Raleigh, N. C. Construction of a new laboratory building at Winter Haven, Fla. will be complete by fall of 1958. The new building will have nine basic laboratories, a number of auxiliary laboratories, offices, and a reading room on the main floor. In the basement, there will be constant temperature rooms, shop, mechanical service rooms, a dark room, and some storage rooms. The pilot plant has been designed with a balcony at one side to accommodate tall equipment.

RESEARCH PROGRAM

Agriculture vitally affects all the people in all parts of the Nation. Its products are worth more than $75 billion at the consumer level. To help solve its complex research problems, the Department of Agriculture seeks advice and assistance from many sources. Under the Research and Marketing Act of 1946 several advisory groups were established. Members of these groups are chosen by the Secretary of Agriculture to obtain a sound representation for all major interests—growers, handlers, processors, transportation and storage groups, marketing groups, as well as the ultimate consumers.

At present, there are twenty-five Advisory and Functional Committees that review and make recommendations concerning the programs of Utilization Research. Various informal research com-

mittees and special consultants provide important help in maintaining an efficient and realistic program.

Each of the Utilization Research Divisions is engaged in research on assigned commodities and in certain well defined fields. The commodities assigned to the Southern Division include:

COTTON	RICE
COTTONSEED	SUGARCANE
PINE GUM	PEANUTS

SOUTHERN GROWN VEGETABLES
CITRUS and OTHER FRUITS
CASTOR, TUNG and OTHER OILSEEDS

The Southern Division serves primarily Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, and Texas.

The program includes fundamental and applied research in chemistry, physical sciences, biological sciences and engineering. Research is generally initiated on a small scale in one of the laboratories where specialized chemical and physical techniques and equipment are used as needed.

When appropriate, on the basis of promising laboratory results, engineers carry out pilot plant studies in cooperation with the group originating the work. These pilot plant studies provide engineering and cost data that will determine whether large scale industrial application is feasible. Occasionally preliminary pilot plant research is undertaken by industry and, when practical, tried out on a large scale in their plants.

The staff of the Division, including field stations, consists of approximately 430 employees. More than 260 are scientists and technicians. The others provide administrative management, operation and maintenance of buildings, and mechanical services. All positions are within the Federal Civil Service.

The Division's research is carried out in seven research laboratories, each under the leadership of a scientist who is a specialist in a particular field. These laboratories include a Pioneering Research Group comprising a Seed Protein Laboratory and a Plant Fiber Laboratory, four laboratories organized along commodity lines and an Engineering and Development Laboratory. Assistance to the research laboratories in fields of instrumentation and

analysis is provided by special groups in the Office of the Division Director.

The Division works cooperatively with many other organizations (State Agricultural and Engineering Experiment Stations, industrial, educational, defense and others) having similar interests or objectives. Some selected research is conducted by outside organizations under contract.

Cooperative research is conducted also within the Division under 8 industry fellowships, 3 sponsored by the National Cottonseed Products Association, 3 by the National Confectioners' Association, and one each by the Canvas Products Association International and the Tung Research and Development League.

PUBLICATIONS AND PATENTS

The Southern Division has been responsible for more than 2,000 publications and patents. A list of publications and patents is issued semi-annually covering the previous six months.

For important work of a patentable nature, a patent assigned to the Secretary of Agriculture is obtained. A nonexclusive license may be obtained, without cost, from the Department to use the invention.

SOME TYPICAL ACTIVITIES OF THE LABORATORIES

PIONEERING LABORATORIES — conduct research of a fundamental nature in scientific fields essential to the program of the Division.

Plant Fibers Pioneering Research Laboratory —

The purpose of the research is to obtain the information needed for a better understanding of textile properties and for the interpretation of the effects of mechanical and chemical treatments. Fundamental studies are conducted on the super molecular structural properties of plant fibers.

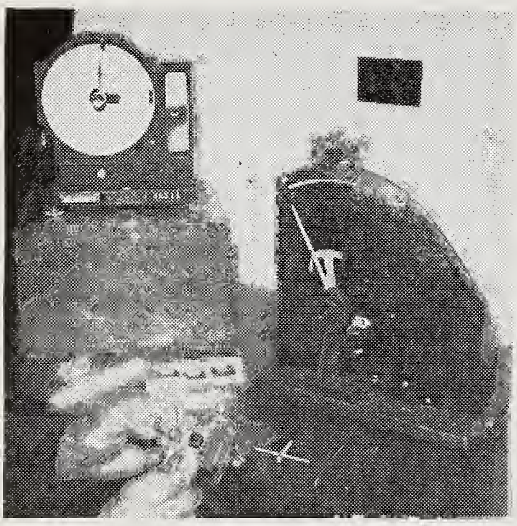
Seed Protein Pioneering Research Laboratory —

Research is conducted on the total protein of seeds, on the proteins of particulate matter in seeds, and on the isolation of pure seed proteins. A principal objective is to secure information that will lead to a better understanding of seed proteins. This information will permit comparison of the fundamental structure of seed proteins with other plant proteins and with animal proteins.

COMMODITY RESEARCH LABORATORIES—conduct research to improve and extend the utilization of Southern farm crops.

Cotton Mechanical Laboratory

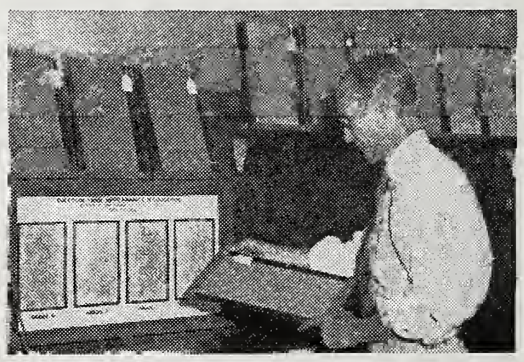
The object of the basic and applied research on fiber properties and structure is to improve the quality of cotton textiles, increase processing efficiency and lower processing costs, develop cotton products for special purposes and design fabrics that will more completely utilize cotton's natural fiber properties.



Both strength and elongation (stretch) at break are measured by this new instrument called the Stelometer, developed under the sponsorship of SURDD at the University of Tennessee.

New and improved methods for measuring physical properties are studied. The development of new testing instruments leads to a better understanding of fiber properties and is basic to other areas of research in this Laboratory.

The individual properties of cotton fibers significantly affect processing efficiency and affect the quality of the finished textile product. Research correlating fiber properties with processing efficiency and with yarn and fabric properties is being conducted as a means of utilizing more completely and functionally the physical properties of cotton fibers.

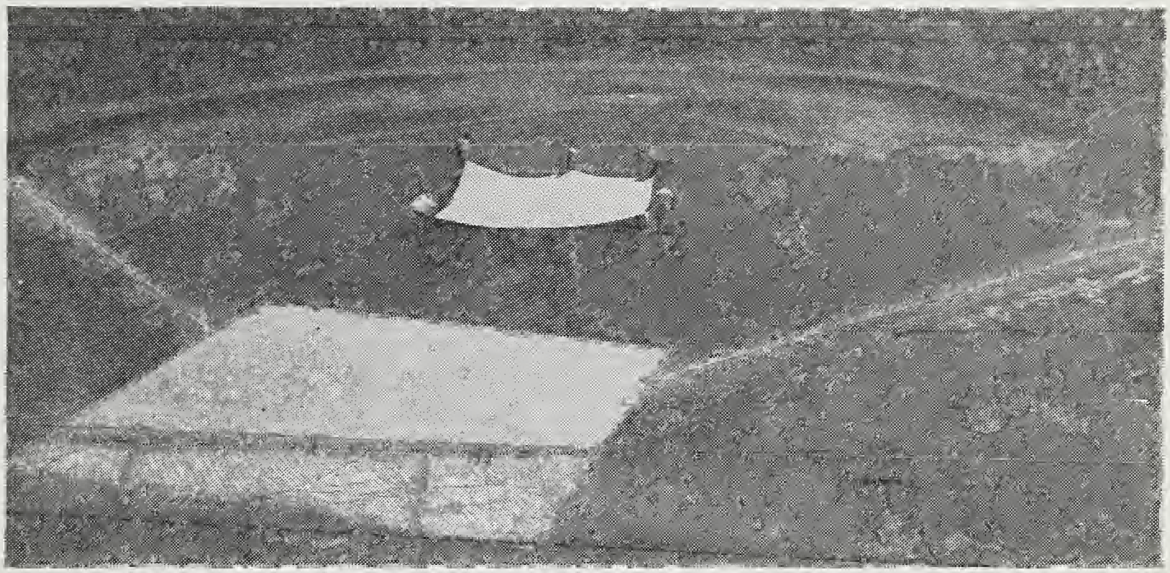


A scientist compares the quality of an experimental yarn spun in the experimental textile laboratory with standards established by the American Society for Testing Materials.

A key operation in processing fibers into textile yarn is drafting, a process by which unoriented masses of fibers are caused to slip past one another in a forward direction with the purpose of producing improved fiber parallelization. Determining the draft distributions required to obtain maximum product uniformity has formed the basis for a major portion of the processing

studies. Research is also conducted to develop methods for efficiently processing chemically modified cotton fibers into quality yarns and fabrics.

The development of new and improved cotton fabrics for specific end uses, and the determination of the practicality of manufacture from a physical and at cost standpoint are important objectives of product development investigations. The evaluation of the processing characteristics and mill adaptability of new varieties of cotton is also an important activity.



Two experimental tarpaulins made of a densely woven, highly wind and water resistant cotton fabric developed at SURDD were still water resistant after being used for six seasons to cover the pitcher's mound and batter's box at Pelican Stadium, in New Orleans.

Cotton Chemical Laboratory —

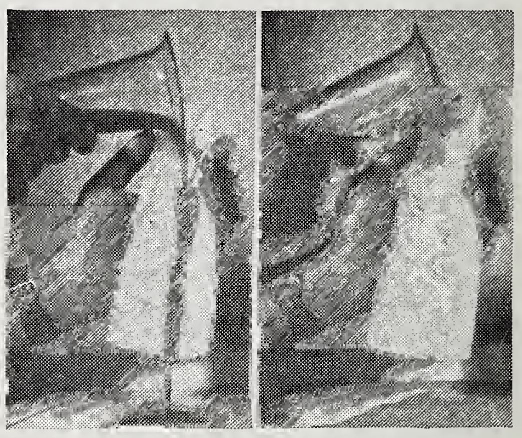
Scientists in this Laboratory devise chemical treatments and processes that will enhance and supplement the natural properties of cotton fiber. Research is both basic and applied, procedures for producing chemically modified cottons range from the synthesis of new chemicals to practical application of chemicals to cotton. These chemicals may react with the cellulose of cotton or with themselves to form polymers. The scientific principles discovered are used as a guide in the invention of new processes for improving cotton textiles.

With the competition of synthetic fibers constantly increasing, methods of imparting superior wrinkle resistance and shape holding properties to cotton fabrics have assumed great importance. Research is under way in this Laboratory in cooperation with the National Cotton Council and other organizations to develop new and improved treatments for minimum care fabrics. Under contract for the Agricultural Research Service, the National Institute of Drycleaning in Silver Spring, Md., is working to develop commercially feasible methods of applying wrinkle resistant treatments to finished garments using standard drycleaning equipment.

A chemist demonstrates the effectiveness of wrinkle resistance and crease retention. The cotton shirt has been hand laundered and drip-dried 51 times; the cotton dress has been laundered and drip-dried 7 times.

Flame-resistant cotton fabrics are desirable for many civilian and military uses. To meet this need, several new ways for making cotton flame-resistant are being studied.

Cotton garments having properties of oil repellency and resistance to grease staining should have industrial applications. They would also be highly desirable in work clothes and household items such as table linens. Research is being conducted to determine the best chemical treatments to obtain these desirable properties.



In the above picture, lubricating oil is being poured onto a piece of treated cotton fabric; the second picture shows that only a few drops of the oil still cling to the surface of the fabric. The oil has not penetrated the threads to make greasy stains which are so hard to remove.

All cotton goods used outdoors, and many indoor fabrics, are degraded by sunlight, fungi and airborne acids. Research has been directed toward the reduction or elimination of the de-

structive effects of these agents. This important work is supported in part by a fellowship maintained by the Canvas Products Association International.

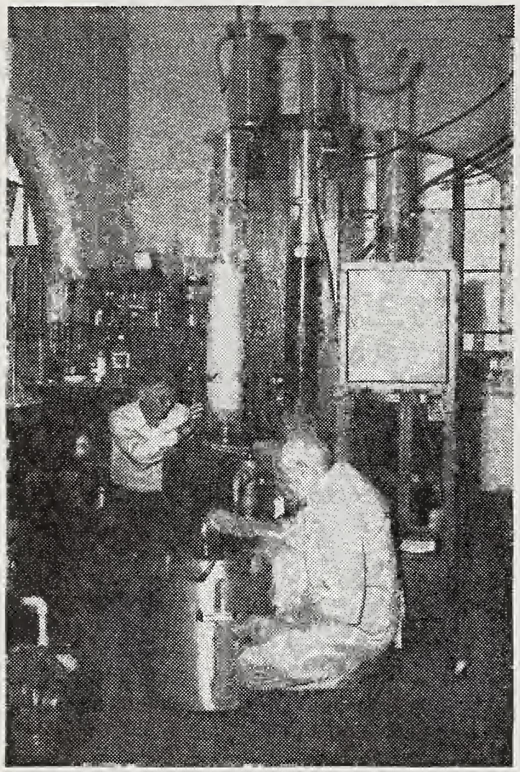
Other typical projects include chemical modifications to impart resilience and rot resistance to cotton; the preparation of cotton cellulose ethers that have changed dyeing properties; and the search for catalysts to hasten chemical reactions with cellulose.

Food Crops Laboratory —

The scientists in this Laboratory determine the composition of selected Southern-grown food crops and study the effect of these different constituents on the yield and quality of processed food products. Chemical, biochemical and processing research is conducted on citrus fruits, sugarcane, rice, cucumbers, sweetpotatoes, southern peas, avocados, and other Southern fruit and vegetable crops. The recovery and utilization of the byproducts obtained during the processing of these crops are also investigated.

Increased returns from growing improved sugarcanes can be realized only if they can be milled and processed efficiently. The American Sugar Cane League provides samples of new varieties for such evaluation. The juices are clarified and processed on a pilot plant scale under a contract with Louisiana State University, at the Audubon Sugar Factory in Baton Rouge, La. Findings are published periodically to inform growers and producers concerning the value of improved cane varieties.

Also under study is the removal of impurities by passing sugar solutions through ion-exchange resins. The quality of the sugar can be improved sufficiently for profitable marketing for direct consumption without further refining. Experiments are being carried out at the Audubon Sugar Factory and at the Puerto Rico Agricultural Experiment Station in Rio Piedras after the Louisiana grinding season to evaluate new ion-exchange resins.

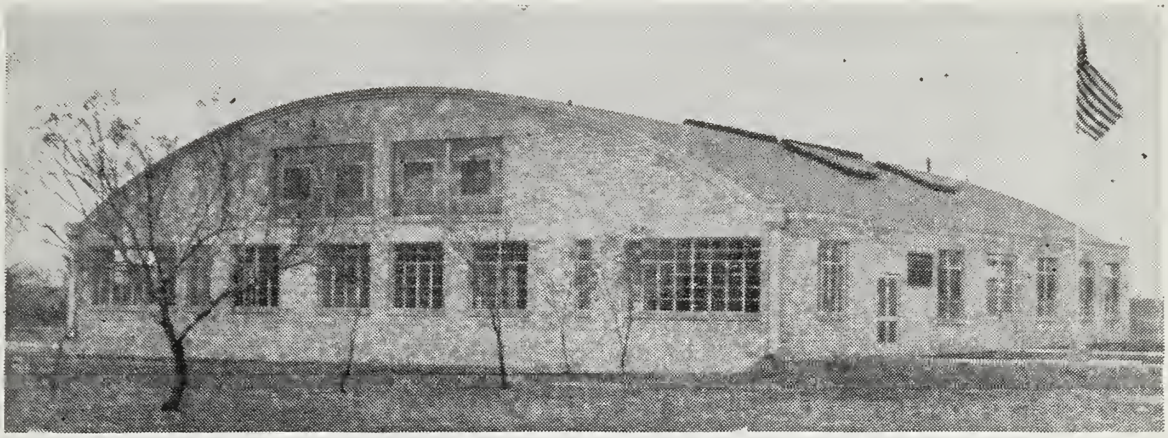


Small scale experiments on the purification of clarified sugarcane juice by means of ion-exchange to produce a direct consumption grade of sugar are being carried out by SURDD chemists. View shows equipment installed in the Audubon Sugar Factory of Louisiana State University.

In a well equipped candy laboratory maintained at the Southern Division and in cooperation with the National Confectioners' Association, new ingredients or modifiers for candies as well as altered formulas and candy-making procedures are evaluated.

Investigations are under way to determine the effect of freezing on the hydration characteristics of cooked rice. Controlled freezing of treated rice brings about structural alteration. Conceivably, advantage may be taken of these changes to develop improved or new rice products.

Research on citrus fruits is conducted at the laboratories in Winter Haven, Fla., and Weslaco, Texas. Major emphasis is placed on the important problems of maintaining and improving the quality of processed citrus products. Undesirable flavors associated with bitter constituents and other off-flavors that sometimes develop in the processed products are investigated.



U. S. Fruit and Vegetable Products Laboratory, Weslaco, Texas.

Another important quality problem under investigation is that of manufacturing juice products of attractive and stable color from pink and red grapefruit.

The research activities in the Food Crops Laboratory include a study of the carotenoids in yeasts, reduction of economic losses in pickle manufacture; new and improved sweetpotato products, an evaluation of varieties of avocados, and improvement of the quality and uniformity of canned southern peas.

Industrial Crops Laboratory —

The objectives of this Laboratory include the development of improved processing methods and new or improved products that can be made from pine gum and turpentine, gum rosin and Southern-grown oilseeds such as cottonseed, peanuts, tung, and sesame.

The chemistry of the principal acids of tung oil is investigated. The results of this research can be applied to the solution of practical problems. Tung oil research is supported in part by a fellowship maintained by the Tung Research and Development League.

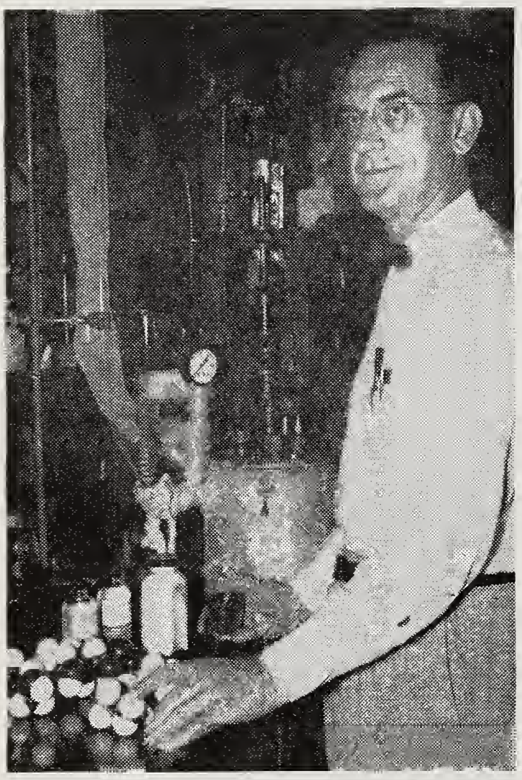
New fat products from cottonseed oils are being developed for use as lubricants, pan greases, and polishing agents. Studies are conducted on fat emulsions for intravenous feeding. Other research includes: Cottonseed oil color problem; cocoa butter-like fats from domestic oils; and the recovery and purification of cottonseed oil acids.

Naval Stores Station, Olustee, Fla.

Oilseed meals as byproducts are a valuable source of feed material. Since cottonseed meal is the most abundant byproduct of this kind, its quality and chemical composition are particularly important. The development of a cottonseed meal suitable for laying hens, chemical and biological measures of the nutritive value of cottonseed meal, supported in part by fellowships of the National Cottonseed Products Association, and the development of valuable chemicals from cottonseed oil soapstock, are being studied.

Derivatives of castor oil are being investigated as plasticizers while the oil itself is being evaluated as a starting material for making urethane foams.

Jojoba *(Simmondsia Chinensis)* is a unique plant because its seeds contain about 50% liquid wax. Because of its chemical structure it is a potential industrial product not only "as is" but also as a source of numerous other chemical products. Research is underway to determine the conditions necessary for the separation of the constitutents of the oil and the development of new products from them.



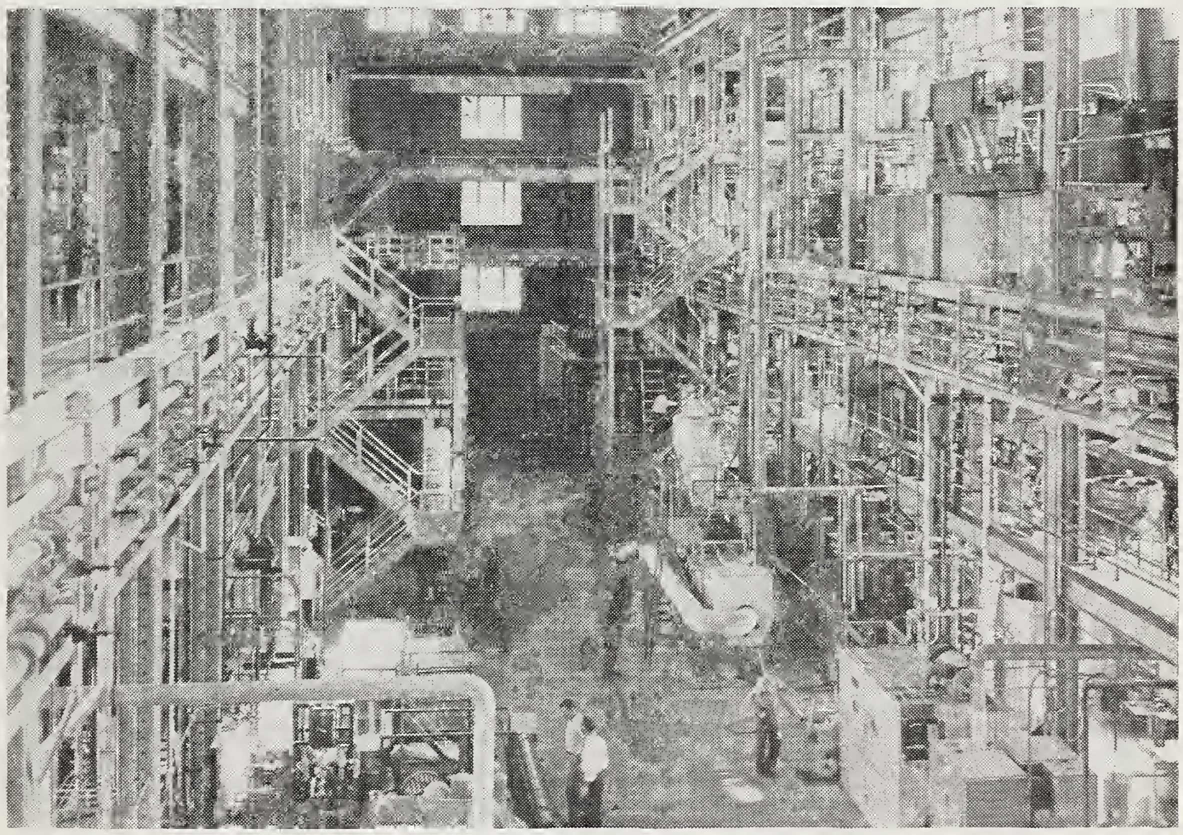
The chemist pictured above is holding gum rosin which is a source of many industrial chemicals. Metal resinates are an example of such products and are potentially useful in paints and special soaps.

To find new uses for naval stores products, research on pine gum, rosin, and turpentine is directed toward the production and evaluation of new derivatives for end products such as coatings, plastics, and printing inks. New or improved processing conditions are evaluated and recommended to the industry where quality improvements or cost savings are indicated.

Engineering and Development Laboratory —

In this Laboratory the main areas of research consist of mechanical and chemical engineering, machinery development, and cost analysis. The engineering and development aspects associated with new, wider and more effective utilization of cotton, pine gum and oilseeds, and Southern-grown food crops are studied.

The major emphasis of the Laboratory's machinery research program is on the development of a completely new system for cleaning cotton, which will give much higher cleaning efficiency than can be obtained with existing equipment. The need for improved methods of cleaning in textile mills has been intensified by the rapidly expanding use of mechanical harvesters and hand snapping. Excessive trash caused by these methods of harvesting creates the difficult problem of satisfactorily cleaning these cottons so that they can be used in manufacturing high-grade textile products.



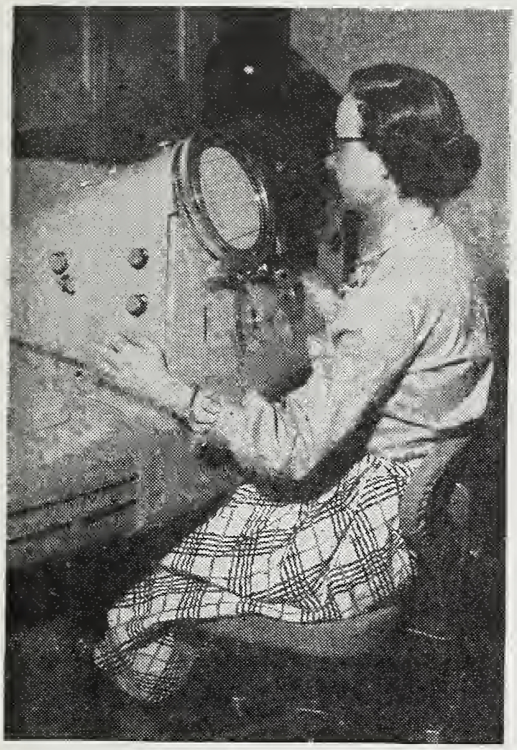
A view of one portion of the pilot plant area, where laboratory processes are tried out on a larger scale. Small pieces of equipment, such as the ovens, or cabinet driers, in the foreground, may be used for one process one week, only to become part of another the week following, while in other cases special items of equipment may have to be built.

A trash problem also exists in delinted cottonseed. Cotton linters are the short fibrous material adhering to cottonseed after ginning. Linters are removed from the cottonseed at oil mills for use in many industrial products. Poor quality linters are caused by increased foreign matter in cottonseed as a result of rough harvesting. The elimination or reduction of foreign matter would contribute greatly to strengthening the competitive position of linters. Efforts are being made to increase the capacity and improve the efficiency of recently developed cleaning machinery.

The Engineering and Development Laboratory takes an active lead in aiding both the product and process development of those chemically modified cotton fibers, yarns and fabrics that have been shown by laboratory research to have unusual promise. Chemical engineering data on the processes are obtained and sufficient quantities of the product are manufactured for field evaluation.

To complement the Division's overall engineering and development program, preliminary cost studies of proposed processes are made. They entail an estimate of the economic feasibility of pilot-plant and commercial development of the process, the desired end product, and the resulting byproducts. The competitive market situation, cost and other economic factors are considered. Assistance in this field is supplied by a representative of the Department's Agricultural Marketing Service, permanently stationed at the Laboratory. When a process proves industrially practical, detailed cost estimates are then determined. Such estimates include equipment and other capital requirements for the manufacture of the product.

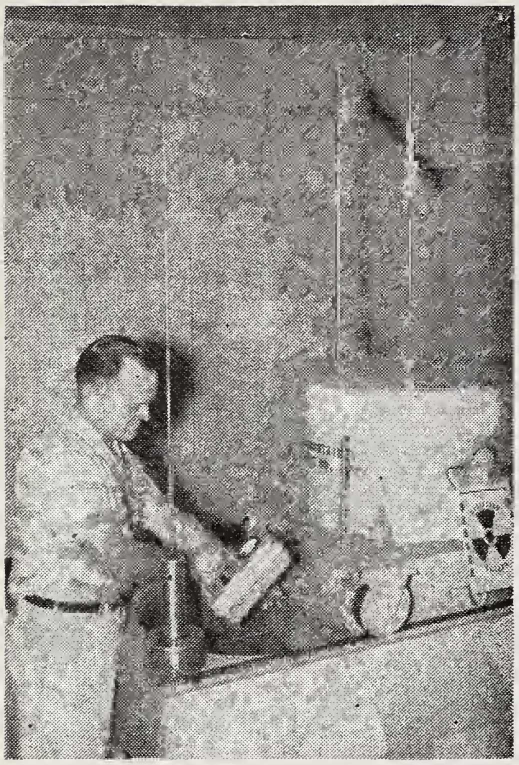
Instrumentation and Analysis Groups —



The electron microscope, which can usefully magnify about 80,000 times, enables research workers to see the cotton fiber as it can be seen in no other way. The specimen under study is mounted on plastic on wire-mesh screen in a vacuum. The image of the fiber is projected on a fluorescent screen or photographed.

The broad research program of the Division requires the use of highly specialized physical, chemical and analytical techniques as well as complex instruments and devices to measure the properties and composition of materials under study. Assistance to the laboratories in special fields of instrumentation and analysis are provided by this group of specialists. New methods of analysis are developed and current techniques are improved. Specialized fields include electron and optical microscopy, spectroscopy, radio-chemistry, analytical chemistry, product evaluation, and the development of new instruments and techniques.

Both light and electron microscopes are used as research tools, permitting a rapid evaluation of experimental results during the development of laboratory methods for the modification of cotton. With the addition of the radiology laboratory, the Southern Division has initiated work in the field of high energy radiation. On June 11, 1957, the Atomic Energy Commission delivered 1000 curies of cobalt-60 for use, as a sealed source, in the investigations of the effects of ionizing radiations on selected materials of agricultural origin.



A chemist is shown monitoring the new cobalt-60 installation. This unit will be used to conduct studies on the effects of radiation on agricultural products.

The purpose of the radiation work is to provide a means of promoting chemical changes in agricultural products that will improve the natural mechanical and physical properties and yield new characteristics.

In the development of modified cotton fabrics for specific end uses, laboratory methods for precisely evaluating the extent of various chemical treatments are of prime importance. A procedure developed for obtaining infrared spectra of cottons is applicable to both untreated and chemically modified cottons. This procedure is invaluable in supplying information to chemists concerning modified cottons, their new structure and degree of modification.

Further assistance is given the research worker in the form of data concerning the physical and chemical properties of the modified product. This coordinated service provides support and guidance for the research worker and assists him in the accomplishment of his objective—new and improved products from Southern agriculture.

SOME ACHIEVEMENTS OF THE SOUTHERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION.

When the Southern Regional Research Laboratory's program was initiated in 1941, no single organization was responsible for conducting research on a large scale to improve and expand the utilization of Southern farm crops. Although agriculture was, and still is, America's most important industry, there was a dearth of scientific information on the composition, properties, and processing of farm crops.

Working in cooperation with many organizations, the Southern Utilization Research and Development Division has provided much new scientific information, both fundamental and applied, on the composition, chemistry, properties and processing of farm crops

in approximately 2,000 published papers and patents. This information has been exceedingly helpful and stimulating to agriculture, industry, defense agencies, consumers, and other research organizations. Probably the value of this new information, although intangible, exceeds the value of the direct tangible contributions of the Southern Division to the national welfare.

Many of the research developments of the Southern Division have —with the aid of other organizations—been commercialized or put to work to benefit agriculture, industry, and the consumer. The cumulative dollar value of these developments has been estimated to exceed $2 billion. Both the profits to agriculture and industry on one hand, and the increased revenue to the U. S. Treasury in the form of taxes on the other, exceed by many fold the cost of the research.

Cotton —

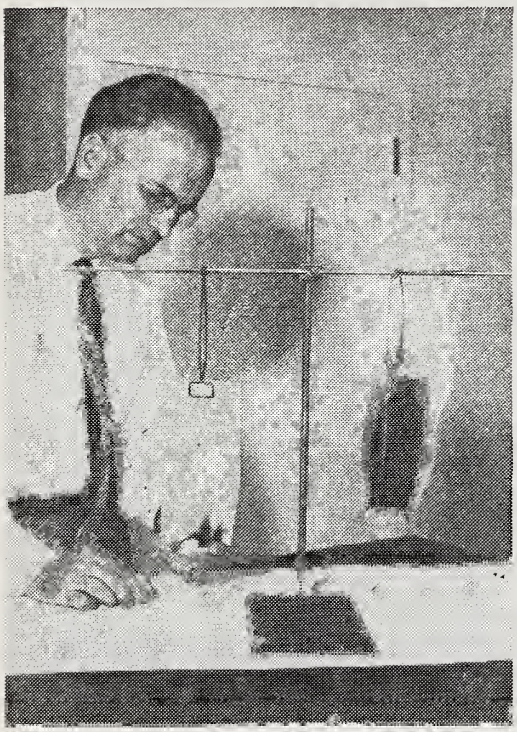
While research has contributed to the competitive position of cotton in a general way, it has contributed more specifically by providing means for improving the quality and uniformity of cotton products—and to some extent—by decreasing costs. The research developments contributing to quality include the differential dye test, the Stelometer, SRRL Cotton Opener, new roving twist formula, roving draft guides and effect of fineness, length and strength of cotton fibers on yarn quality and processing efficiency. Although there is no way of calculating quantitatively the effect of these developments on cotton consumption, they have had, and are having, a substantial effect on the use of cotton fabrics in clothing and household articles in competition with those made from other fibers. it can be conservatively estimated that these developments are the major factors that have accounted for the consumption of at least 750,000 bales. The value of this cotton is more than $110,000,000.

Partially acetylated (PA) cotton fabrics have much greater resistance to heat damage and scorching than does the untreated fabric. This was demonstrated by comparative tests in a commercial laundry. The untreated press cover (left) was badly scorched after some 30 hours use, while the PA press cover remained in good condition after 120-140 hours service.

Chemical Treatments of Cotton —

Cotton, a versatile fiber, meets more different types of consumer needs than any other fiber. But for all its usefulness, cotton has lost ground to other fibers in some applications, because it is inadequate or lacking in special properties. Natural cotton is not so rot-resistant as some of the synthetic fibers. It is less water-absorbent than flax. It is less flame-resistant, soil-resistant, and resilient than wool. It is weaker and less elastic than silk. By chemical treatment, cotton can be transformed into new textile materials that retain the desirable characteristics of the original cotton and acquire new or improved properties.

A number of new, chemically modified cotton products have been developed. One is partially acetylated cotton, produced commercially by a process developed at this Laboratory. It is being used in covers for home ironing boards because of its superior heat resistance. "PA cotton" is also better than plain cotton in rot resistance, electrical properties, and in resistance to some acids and chemicals.

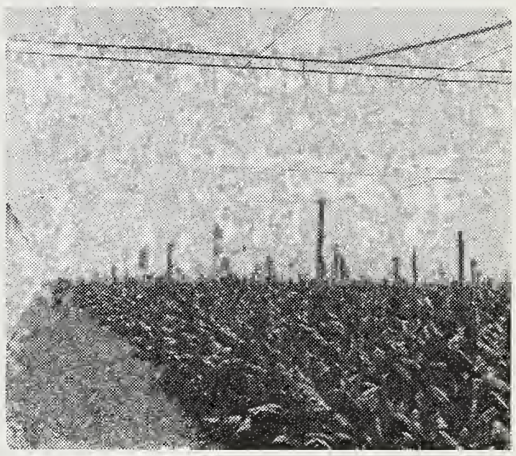


Cotton fabric treated with the THPC-BAP flame resistant process is compared with untreated fabric. The untreated fabric is blazing vigorously, while the treated fabric shows charring only in fabric areas in direct contact with the flame. The finish remains effective even after repeated launderings.

Many organizations, including the Southern Division, have made substantial research contributions to the development of cotton wash-wear or "easy care" products. Contributions of the Southern Division include the acquisition of helpful fundamental information, development of improved formulations, research on chemical treatments that avoid chlorine bleach damage and provide rot and flame resistance in addition to wash-wear properties, and pioneering work on treatment of garments instead of fabrics. Treatment of the garment has the advantage that both wrinkle resistance and durable creases—in the desired places—are provided.

Flame-resistant treatments for cotton textiles have been developed in cooperation with the Quartermaster Research and Development Command. An example is a treatment based on the use of tetrakis-(hydroxymethyl)-phosphonium chloride, called THPC. The necessary chemicals can be applied with conventional processing equipment and finishing methods to give products with permanent flame and glow resistant properties.

A treatment to make cotton tobacco shade cloth more durable in exposure to sunlight has been developed. An inexpensive mineral pigment, lead chromate, applied to the cloth, minimized the damage caused by ultraviolet rays. Cotton manufacturers produce treated shade cloth and sell more than a million yards each year to tobacco growers in North Florida. The treated cloth can be used as top cover for three seasons in contrast to one season for untreated fabric. Estimated savings to growers is $200 per acre each season; furthermore, this development has greatly lessened the possibility of synthetic fiber fabrics displacing cotton from this market.

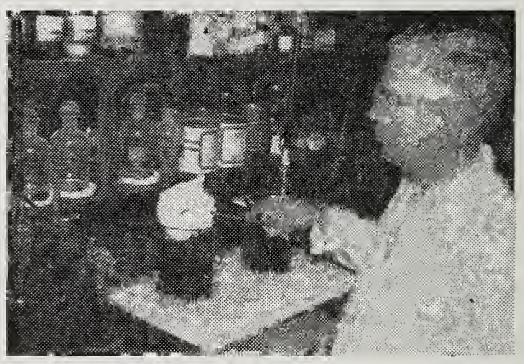


Shade cloth treated by a simple, economical chemical process developed at SURDD shades growing tobacco plants. This application requires resistance to sunlight and bacterial degradation.

This demonstration points out the advantages of semi-elastic cotton gauze bandage. When the bandage is wrapped about active joints, its qualities of elasticity permit the material to stretch comfortably and then return to a smooth, neat fit. Although the bandages in the illustration are not secured in any way, their crepe-like texture holds the layers in place, whereas the slippery texture of an ordinary gauze bandage allows the layers to slide and fold up.

A special manner of shrinking by mercerizing cotton gauze gives a new surgical bandage of superior elasticity and clinging power. The all-cotton bandage fits snugly, allows more freedom of elbow, knee, wrist, or ankle than an ordinary bandage. This elastic bandage is produced commercially for civilian use, as well as for the Armed Services. The new product, which costs less than other special bandages, has saved several million dollars for the taxpayer.

Aminization, phosphorylation and sulfo-ethylation are other processes for chemically modifying cotton. These products have several advantages and new properties, including ion-exchange capacity. Other important processes and products stemming from SU research include a process to permit the re-use of cotton fertilizer bags; fabrics having repellency to water, oil and stains; alkali-soluble fabrics; location cleaning of cotton carpets; and vat-dyed acetylated cotton with built-in weather resistance.



The differential dye test has been widely adopted by textile manufacturers as a part of their standard cotton testing procedure. The test gives cotton textile mills a quick, reliable method for testing fiber quality, and greatly reduces losses from uneven dyeing of the woven fabric, or defects due to neps.

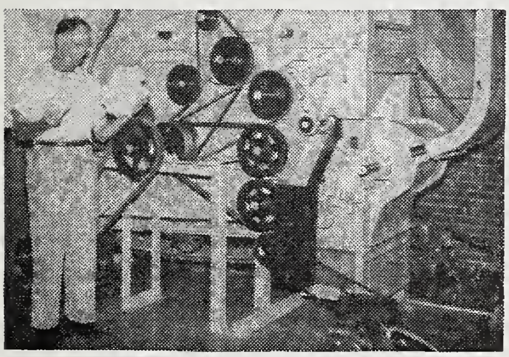
Cellulose consists of long, unbranched chains, made up of

cellobiose units, each of which contains two anhydroglucose members. New, fundamental research indicated that the cellulose molecule may be even much longer than previously reported. To aid in studying this subject further, two improved viscosity techniques for determining molecular weight were developed. They have been adopted by the American Society for Testing Materials.

A technique was developed for loosening and stripping cotton's outer wall from the rest of the fiber. Sufficient quantities of the wall for observations of structure under the electron microscope and for chemical analyses were obtained by this technique. The information acquired is being applied to investigations of the role of the outer wall in conventional chemical finishing treatments, such as kiering, bleaching, and mercerizing.

Cotton Processing Machinery and Techniques —

A new cotton-opener has been developed which gives the best means yet devised for opening and fluffing tightly baled cotton at textile mills. Cotton so fluffed can be better cleaned by standard cleaning equipment, and less spinnable fiber is wasted. Yet, the unique fluffing action causes no damage to the fibers. In a 6-year period, enough openers have been installed in textile mills to process about 1 ½ million bales of cotton annually. One mill processing about 40,000 bales a year has saved up to a dollar a bale through less waste, and has achieved cleaner picker laps, better blending, no increase in neps, an increase in yarn strength, and improved appearance of yarn. On a 15-million bale crop, the potential savings to the textile industry range from about 7 to 15 million dollars annually.

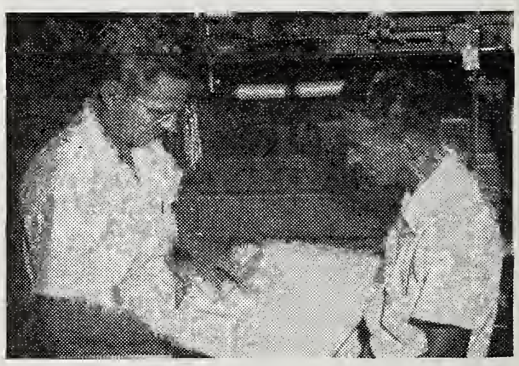


Efficiency of the Cotton Opener Cleaner in the background is shown by the two bundles of cotton; the large, fluffy bundle has gone through the Opener-Cleaner while the smaller bundle has been opened and cleaned by ordinary methods.

After successful evaluations on a pilot plant scale had been completed, a new Opener-Cleaner was made available to the textile industry. The new machine retains the exceptionally good opening and blending ability of the original SRRL Opener and, in addition, is a highly effective cleaner. The waste removed by the machine is composed of about 85% trash and 15% short fibers, which is about double the cleaning and one-half the fiber loss of conventional textile equipment. Six manufacturers of textile machinery are licensed under USDA patents to produce this machine.

An attachment has been devised for use on looms which permits insertion of more filling threads to the inch than that permitted on standard looms. Extra-tight fabrics woven in this way are more water- and wind-resistant than conventional fabrics. Fabrics woven with the aid of the device look better, are more uniform, and are somewhat stronger than those woven without it. The loom attachment has been constructed for experimental use by about 30 mills. It is commercially available from two textile machinery manufacturers.

A lightweight steep-twill cotton fabric designed and developed at the Southern Division was officially adopted by the Department of the Navy for use in their summer flight uniform. Following extensive field tests the Navy Department issued Military Specification C-18387 A (Aer) for use in procurement of summer flight suits made from this fabric.



Technologists inspect a light weight steep twill cotton fabric designed and developed at SURDD.

Recent research has shown that significant improvements in yarn quality and processing efficiency can be obtained through the proper distribution of drafts and the use of proper twist in the roving on long-draft roving systems. It is estimated that the use of these two developments by the cotton textile industry has resulted in savings to date of approximately $20 million, and has retained a market of approximately 100,000 bales of cotton.

A method has been developed for measuring yarn softness, an important yarn property for which there had been no satisfactory quantitative measurement. This test allows selection of the optimum single and ply twist combination to obtain the best compromise between several yarn properties pertinent to the construction of fabrics of improved tear strength, drape, permeability, coverage, abrasion resistance, and amenability to chemical finishing.

Cottonseed —

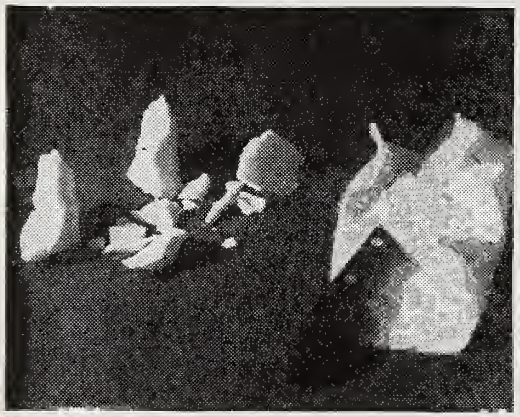
As a result of research to improve its nutritive value cottonseed meal has gained a new status as a feed, particularly for nonruminant animals. Some cottonseed oil mills are now producing the new meals for use in mixed feeds. These advances were achieved by cooperative research on a broad scale, with participation by members of the National Cottonseed Products Association, State Agricultural Stations, nutritionists, other agencies of the Department of Agriculture, university laboratories, and numerous oil mill operators. Annual gains to the industry through the availability of cottonseed meal of improved nutritional value could amount to about $50 million.

The first cottonseed oil mill to adopt the ARS filtration-extraction process began successful operations in 1954. Plant profits increased $750 per day when the plant shifted from the old hydraulic processing to filtration-extraction. Simple to operate and economically attractive for smaller mills, the plant can shift easily from cottonseed to soybeans and vice versa. Small-scale processing tests indicate that filtration-extraction is applicable to many other oil-bearing materials, including sesame, peanuts, rice bran, flaxseed, castor beans, jojoba, and milo germ. Two filtration-extraction plants in Mississippi and one in South America are now in commercial operation.

Cottonseed pigments, if not removed or inactivated, detract from the nutritional value of meal and discolor the oil. In fundamental research it was discovered that related pigments, in addition to the long-known light-yellow pigment gossypol, occur in seed glands. A wealth of information on the structure of gossypol and the related pigments and their effects on oil color and meal quality has been accumulated.

A group of chemicals have been discovered which, when used in connection with laboratory and pilot plant scale refining and bleaching, improve the color of poor quality cottonseed oils. Such treated oils have color comparable with prime oils. One compound, diethylenetriamine, is effective in removing pigments or color bodies from crude oil that cannot be removed by conventional refining and bleaching. The mechanical feasibility of this process for plant scale operations has been verified.

By substituting acetic acid groups in glycerides of cottonseed or peanut oil, two kinds of new fats have been developed:



The solid lumps and the flexible, wax-like sheet shown were made from cottonseed oil, through the intervention of chemistry. The acetoglycerides are derived from cottonseed and other vegetable oils. Among the products developed is a special margarine-like spread having a desirable consistency at temperatures ranging from Arctic cold to tropic heat.

Acetostearins and aceto-oleins, each tailored for different specific uses. Both types have potentialities for non-food uses, such as components of plastics. They offer possibilities as coatings for meat products, cheeses, fruits, and nuts. The products can be prepared to have sharp melting points, in the range of 80°-140° F. Below their melting points, to as low as 20° F., acetostearins are unusual in that they are nongreasy and flexible. These modified fats are virtually odorless, colorless, and tasteless, and resist rancidity and other forms of deterioration.

A method for measuring the hardness of fats and their softening range is highly useful to confectioners and oil processors. It has been applied to the determination of the hardness of fats ranging from a soft candy fat to carnauba wax, as well as to study the changes in hardness of candy fat or chocolate during tempering. This method will make it possible to establish a quantitative basis for measuring the softening characteristics of these important candy coatings.

As a consequence of research on fats and oils, "tailor-made" or modified fats, and products derived from these materials were prepared. Many of these natural and derived fatty materials were characterized with respect to their more important physical properties. These properties are important factors in determining the design of equipment and the development of processes. This basic information is vital to a large portion of the fat and oil industry which is devoted primarily to the altering of the physical properties of fatty products to meet specific consumer demands.

Tung and Tung Products —

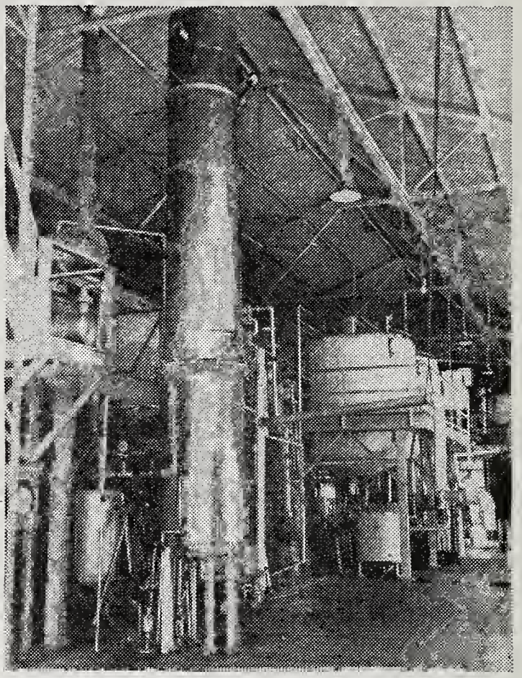
Information of practical value to the tung grower and industry has been obtained on ways to improve practices of handling and processing tung fruit and tung oil.

Methods were developed for utilizing tung oil derivatives with newly available chemicals for the production of superior protective coatings. The products, technically known as epoxy coatings, possess outstanding adhesion, high chemical resistance, unusual flexibility, extreme hardness, and have superior resistance to water. They dry rapidly. Pigments and flush colors may be incorporated to provide films of unusual gloss, mar resistance and depth of color with good color retention on aging. Incorporation of potentially fungicidal acids in these products promotes resistance to mildew.

In developing entirely new uses for tung oil, the molecular structure of alpha-eleostearic acid—the major constituent of tung oil—was established. This fatty acid is unusually adaptable to molecular alteration through the introduction of other chemical groups. Its structure and properties have been investigated by use of infrared techniques and binary freezing-point procedures. The results of this fundamental research are of immediate potential value to the industry.

Naval Stores: Pine Gum, Turpentine, Rosin —

Largely as a result of research conducted by the Department of Agriculture at the Naval Stores Station in Olustee, Fla., at least 20 centrally located modern processing plants today process about 98 percent of the United States pine gum crop by modern, efficient methods. Four research developments in particular have led to this modernization: Standardized methods of marketing crude gum; steam - distillation; the Olustee gum-cleaning process; and the continuous turpentine still.



The first successful continuous still for the distillation of pine gum, as developed and constructed at the Naval Stores Station in Olustee, Fla.

The continuous turpentine still requires only 50 percent as much steam as a batch still of the same capacity, and since it is automatically controlled, an additional saving is realized. The combined savings amount to $20,000 per year, according to a statement by one industrialist.

Rosin has been improved for use in metal resinates for coating materials. The new products, which contain a higher proportion of combined metal than other fused resinates, are more soluble and have greater resistance to damage by oxidation. These metal resinates are being evaluated as paint driers, wood preservatives, special soaps, and corrosion inhibitors in greases. Licenses to operate under the two patents obtained on this process have been granted to manufacturers.

Pine gum, a complex mixture of organic substances, offers almost limitless potentialities for the development of new products. One new product, made directly from pine gum, is maleopimaric acid. This chemical is being produced commercially. It is of interest for use in plasticizers, resins, emulsifying agents, photographic chemicals, paper coatings, varnishes, printing inks, and similar products.

Pinane and menthane hydroperoxides, produced from components of turpentine, have proved to be superior catalysts in the manufacture of S-type cold rubber. This type of synthetic rubber is the most widely produced in the United States. In the past three years, annual production of this rubber has increased to about a million tons, with a proportionate increase in the use of hydroperoxide catalysts.

Pinic acid, a product from the oxidation of alpha-pinene, yields esters that are suitable as lubricants for turbojet engines used in modern aircraft. Pinic acid esters may be used as plasticizers, especially where flexibility at low temperatures is desired. Other potentially valuable products, including polyester resins, polyamides, and urethane polymers, can be made from pinic acid.

The composition of rosin can be controlled to give a product containing essentially the resin acids in pine gum. If desired, any intermediate composition between the original pine gum and the completely isomerized rosin can be obtained. These changes are controlled by the partial or complete neutralization of the carboxyl groups in the pine gum before processing.

Peanuts —

The manufacture of peanut butter consumes as much peanuts as all other peanut food products combined — about 335 million pounds in 1956-1957. A basis for determining the conditions for roasting and other processing operations to produce peanut butter of excellent flavor and keeping quality has been obtained through pilot-plant investigations. Findings in another study have made it possible to select—on the basis of physical properties—hydrogenated peanut oil for commercially stabilizing peanut butter. The incorporation of hydrogenated oil in adequate amounts under proper conditions provides peanut butter free of oil separation. Improved continuous processes for the addition of Vitamin A to peanut butter have been developed.

Southern Division researchers have described procedures for the analysis and evaluation of peanut butter and peanut skins and other byproducts of manufacture. A modified technique for determining the stability of vegetable oils reduces by 60% the time usually required to make this test. Another modified method gives consistently reproducible values for the moisture content of peanut butter.

Candy —

In an investigation of the value and proper application of antioxidants in stabilizing candies incorporating various fats, it was found that animal fats, but not high-grade vegetable fats, require stabilization against oxidation. This protection is provided by incorporating brewers' yeast and specially prepared oat flour into fats. These, in addition to being nutritive ingredients, contain effective antioxidants. Butter mints incorporating yeast have been marketed by several firms.

Citrus Fruit —

The first frozen concentrated orange juice to be put on the market that closely resembled the fresh juice in flavor, aroma, and vitamin content, was largely the result of cooperative research with the Florida Citrus Commission conducted at the Southern Division's Winter Haven Laboratory. Manufacture of this improved frozen citrus product has brought many millions of dollars to citrus growers each year. The annual retail value of frozen orange concentrate is well over $200 million. In 1956-57 more than 72 million gallons were produced in Florida, using about 48 million boxes of oranges, more than half the crop of the state. Similar frozen concentrates can be prepared from grapefruit, tangerine, and blended orange and grapefruit juices.

Research established that citrus molasses may be added to citrus pulp to enrich its feed value without appreciably increasing its tendency to absorb moisture, and without introducing new storage problems. The advantage to processors is the greater ease of handling one combined product, as compared to the handling of two separate products, one a liquid and one a dry feed.

Cucumbers —

Several achievements of outstanding value to the cucumber pickle industry have resulted from research carried out jointly by the Division's Food Fermentation Laboratory and the North Carolina Agricultural Experiment Station in cooperation with commercial packers. A specially adapted pasteurization process greatly enlarged the market for cucumbers by making available a new type of pickle, namely, fresh-pack, prepared without the usual fermentation and curing in brine. Fresh-pack pickle products are made from about four million bushels of cucumbers a year, bringing some $5 million to growers. The annual retail value is about $45 million.

Other investigations demonstrated that softening spoilage of cucumbers during brine fermentation and curing is caused by enzymes that break down the cell structure. These enzymes originate in molds growing on cucumber flowers that adhere to the cucumbers and are thus carried into the brining vats. Sensitive tests for softening enzyme activity were developed. If brines in which rapid buildup of such activity is detected are drained off after 36 to 48 hours, and replaced by fresh brines, softening can be greatly reduced or eliminated. Adoption of this procedure by the pickle industry has resulted in substantial reduction in losses estimated to have previously been as high as $1 million annually.

The subsurface gaseous fermentation activity of yeasts is one of the main causes of "bloaters." These hollow pickles are another cause of serious economic loss, since they have to be diverted to products of lower value. Recent experiments have demonstrated the possibility of reducing the formation of bloaters by treatments that inhibit the activity of the gas-producing organisms.

Sweetpotatoes —

A process for making high quality white starch from sweetpotatoes, used for 10 years in a factory owned by a farm cooperative at Laurel, Miss., was improved in research at the Southern Laboratory. Its application in a large commercial plant in Florida demonstrated that the plant design, equipment, and process were satisfactory. The plant ceased operation in 1947 because acreage yields of starch were much lower than had been estimated and the costs of growing the crop had increased. Industrial use of the starch-manufacturing process depends primarily on development of cultural practices and farm equipment that will substantially lower the costs of growing sweetpotatoes.

Sugarcane —

Aconitic acid has been known for more than 75 years as the principal organic acid in sugarcane and derived products, but previously no practical method had been devised for separating it from the sirups or molasses. Half a million pounds of aconitic acid are recovered annually by a Louisiana sugar mill from sugarcane molasses by a process developed cooperatively by the Southern Division and sugar mills. Its value to date is estimated at more than $1.5 million. Esters of aconitic acid are used as plasticizers and in synthetic detergents. More complex derivatives than the esters are of interest as plant growth regulators and possibly in pharmaceutical or medical applications.

Practical demonstrations showed that the farmer loses money by not delivering cane to the mills as soon as possible after harvesting. Average monetary losses were calculated, based on a 25-ton per acre yield, to range from about $20 per acre for a delay of three days to as much as $40 per acre for a delay of seven days. Following this work there has been marked improvement in the freshness of cane received by the mills with consequent substantial increase in payments to growers for the better quality cane, as well as savings for the factories in processing the fresher material

Rice —

Improved procedures for milling rice, developed under contract at the pilot-plant rice mill of the University of Arkansas' Institute of Science and Technology, Stuttgart, Arkansas, are ready for commercial evaluation. It is anticipated that their use by mills will result in less breakage of rice grains and a higher yield of whole grain (head) rice.

A process was developed for separating rice wax from the other materials removed during rice oil refining—the wax byproduct has potentialities for commercial uses. In addition, a method was developed which leads to the reduction of "fines" in the miscella (oil-solvent mixture) produced during extraction of rice bran.

New Research Methods and Data —

Numerous evaluation methods and equipment have been developed to study the composition and the physical and chemical properties of agricultural commodities.

Determinations have been made of the content of organic acids in cotton; pigments in peanut skins; and trace metals in cotton and cottonseed. Analytical methods have been developed for determining copper in textiles; the pH in textiles and in cotton fiber; formaldehyde in cellulose formals; sulfate in nitro-cellulose; starch in sweetpotatoes; gossypol in cottonseed and cottonseed products; inorganic phosphorus in plant materials; carotene; glycosidic methoxyl groups; and pectic substances. Spectrochemical methods have been developed for the analysis of vegetable oils. Investigations have been made of viscosities and densities of vegetable oils and their solutions in organic solvents; phase relations of vegetable oil and solvent mixtures at low temperatures; infrared spectra; the porosity of fabrics; and the heat resistance of partially acetylated fabrics. New or improved instruments include an automatic recording balance and a device for measuring the thermal transmission properties of fabrics.

These and similar research methods and data are essential to expedite research and are valuable to industries concerned with the utilization of agricultural commodities.

GENERAL INFORMATION ABOUT THE FOUR UTILIZATION RESEARCH DIVISIONS

Division	Director of Division	Mailing Address	Division Area*	Fields of Research
Eastern	P. A. Wells	600 E. Mermaid Lane Philadelphia 18, Pa.	Conn., Del., Ky., Maine, Md., Mass., N. H., N. J., N. Y., Pa., R. I., Vt., Va., W. Va.	Eastern deciduous fruits; Eastern vegetables; meat; dairy products; animal fats; hides, tanning materials and leather; honey; maple-products, tobacco; wool byproducts; plant precursors of cortisone; biologically active plant compounds; and allergens of agricultural products.
Northern	W. D. Maclay	1815 N. University St. Peoria 5, Illinois	Ill., Ind., Iowa, Kans., Mich., Minn., Mo., Nebr., N. Dak., Ohio, S. Dak., Wis.	Agricultural residues; corn, wheat, and other cereal crops; soybeans and other oilseed crops; new crops.
Southern	C. H. Fisher	1100 Robert E. Lee Blvd. New Orleans 19, La.	Ala., Ark., Fla., Ga., La., Miss., N. C., Okla., Puerto Rico, S. C., Tenn., Texas.	Cotton, cottonseed; tung fruit; peanuts; rice; sugarcane; pine gum; citrus fruits; sweetpotatoes, cucumbers, and other vegetables.
Western	M. J. Copley	800 Buchanan Street Albany 10, California	Alaska, Ariz., Calif., Colo., Hawaii, Idaho, Mont., Nev., N. Mex., Oreg., Utah, Wash., Wyo.	Western fruits and tree nuts; Western vegetables; poultry products; alfalfa and other forage legumes; wheat; rice; wool and mohair; sugar beets; and dry beans and peas.

*States listed are those primarily served by the particular Division, although the research programs of each Division are of national scope and interest.

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